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Larry Ogren
National Marine Fisheries Service, NOAA
Panama City Laboratory
3500 Delwood Beach Road
Panama City, Florida 32407

Charles McVea, Jr.
National Marine Fisheries Service, NOAA
Pascagoula Laboratory
P. O. Drawer 1207
Pascagoula, Mississippi 39567

Apparent Hibernation by Sea Turtles in North American Waters

ABSTRACT

Only 2 documented occurrences of aggregations of torpid sea turtles overwintering in North American waters have been reported. These areas are Baja California, Mexico, and Cape Canaveral, Florida, and include populations of the Pacific green turtle or black turtle (*Chelonia mydas aggassizi*) and the Atlantic loggerhead (*Caretta caretta*), respectively. Fishermen have also reported that hibernation by sea turtles apparently exists elsewhere in the Gulf of Mexico at approximately the same latitude, 29° N. These observations remain to be confirmed but should be given serious consideration, especially those on the overwintering populations of Kemp's ridley (*Lepidochelys kempi*) and Atlantic green turtles (*Chelonia m. mydas*) at Cedar Key, Florida.

It is evident that not all individuals within a population of sea turtles or residing in a particular geographic area hibernate in response to low water temperature. Dormancy occurs at temperatures below 15° C, both in the Baja California population of green turtles and the Cape Canaveral population of loggerhead sea turtles. The Cape Canaveral sea turtles do not appear to hibernate every year. Observations of cold-water stunning of sea turtles in the lagoon systems of Florida's central east coast suggests that the lower lethal temperature may occur below 8° C.

Additional information is needed to determine the degree and extent of this little-known aspect of sea turtle life history.

Introduction

Winter dormancy or aggregations of torpid sea turtles has been reported by Felger, Cliffton, and Regal (1976), and Carr, Ogren, and McVea (1980) for the Pacific green turtle or black turtle (*Chelonia mydas agassizi*) and the Atlantic loggerhead (*Caretta caretta*), respectively. Much earlier, Carr and Caldwell (1956) mentioned fishermen's reports of overwintering popula-

tions of Atlantic green turtles (*Chelonia m. mydas*) and Kemp's ridley turtle (*Lepidochelys kempi*). Scuba divers with the Georgia Office of Coastal Resources have observed lethargic sea turtles during winter months off the Georgia coast on reefs at depths of 30 to 36 meters (J. Richardson, personal communication). More recent reports by fishermen encountering lethargic, mud-covered sea turtles in their trawls exist for the northern Gulf of Mexico but remain to be documented. Thus, the only documented records of apparent hibernation by sea turtles are for the Baja California population of green sea turtles and the Cape Canaveral, Florida, population of loggerhead sea turtles (Felger, Cliffton, and Regal 1976; Carr, Ogren, and McVea 1980). In the light of these recent discoveries, serious consideration should be given to the reports by fishermen of Cedar Key, Florida, of overwintering green and ridley turtles in that area. More evidence will be required to document other reported occurrences of apparent hibernation elsewhere in the northern Gulf of Mexico and off the Georgia coast.

Indications are that all individuals within a population of sea turtles or residing in a particular geographic area do not hibernate in response to periods of low water temperatures (Carr, Ogren, and McVea 1980). During these periods, some individuals apparently migrate to warmer latitudes or depths. Dormancy occurs at temperatures below 15° C (Felger, Cliffton, and Regal 1976; Carr, Ogren, and McVea 1980). If the temperature drops much lower, however, and if suitable bottom type and depths for seeking refuge are lacking locally, or are too distant or blocked by physical barriers, cold-stunning or immobilization and death occur. This latter phenomenon was reported in detail by Ehrhart (1977 and 1978) and occurred in the Mosquito Lagoon–Indian River estuarine system on Florida's east coast during the winter of 1976–77 and to a lesser extent in 1977–78. The majority of sea turtles affected were immature greens; the others were loggerheads except for a single Kemp's ridley. The low temperature of 4° C was recorded for this shallow bay area, but it was believed that the lethal temperature was reached at a somewhat higher value but below 8° C (Ehrhart 1978). Schwartz (1978), in temperature tolerance observations performed under semicontrolled conditions, for example, concrete tanks and ambient seawater temperatures, determined that death occurred for 3 species of sea turtles exposed to 4° C to 5° C for 12 to 24 hours. Wilcox (1898) also reported cold-stunning and mortality of sea turtles in the Indian River area during the unusually cold winter of 1894–95. Another very cold winter in 1899, along the Texas coast, resulted in an almost total loss of the green sea turtle net fishery (H. Hildebrand, Texas A&I Biological Station, 19 September 1978, personal communication).

The occurrence of turtle cold-stunning and subsequent mortality within the principal nesting, foraging, or developmental areas for the loggerhead, green, and Kemp's ridley sea turtles does little to reinforce our belief in the apparent hibernation by these sea turtles—in fact, they suggest the opposite. However, it is important to note that these mortalities have occurred in shallow estuarine waters, such as those of Florida's central east coast. Cold fronts or "northers" pass through these areas during the winter months and lower the water temperature rapidly. Escape to deeper and warmer waters offshore is blocked by long barrier islands, and exposure to numbing and sometimes lethal temperatures results. Not all the winters are severe, however, and exposure to this limiting factor is infrequent. Apparently, some of the turtles that occupy this habitat have not evolved a strategy to avoid low temperatures.

Offshore, where the only 2 records of apparent hibernation have been reported, conditions are different from the coastal lagoons. Sea turtles occupying offshore habitats have a ready access to deeper and warmer waters at this latitude (29° N) during unusually cold winters. Water depths and minimum temperature observed for torpid green turtles in Baja California in January 1975, were 8 to 10 m and 14° C (Felger, Cliffton, and Regal 1976). Similarly, torpid loggerhead turtles were found in the Port Canaveral ship channel in February 1978, at a depth of 15 m and a mud substrate (bottom) temperature of 13.9° C (Carr, Ogren, and McVea 1980); the deep cloacal temperatures of the loggerheads were nearly identical (Figures 1 and 2).

In the nearshore waters of more northern latitudes off Georgia and the Carolinas the overwintering Atlantic loggerhead would be regularly exposed to seawater temperatures lower than 10° C. Offshore movements and southern migrations of these turtle populations during winter months to avoid these low temperatures are suggested by Scuba diver reports of turtles occupying deepwater reefs and fishermen's observations of active turtles at the surface along the western edge of the Florida Current (Gulf Stream). The absence of turtle sightings in coastal waters and bays and observations of torpid turtles in the deeper waters offshore support the belief that seaward movements of coastal-dwelling loggerheads occur at these latitudes during winter months. The extent of this behavioral response to cold water exhibited by sea turtles offshore the southeastern United States needs to be thoroughly explored.

Methods

Monthly trawl surveys of the Cape Canaveral ship channel and bight were begun in October 1978 by the National Marine Fisheries Service (NMFS) to determine if sea turtles would be found hibernating as they apparently had the preceding winter. These monthly

surveys were continued through the summer of 1979. In February 1979, NMFS initiated additional trawl surveys of potential overwintering sites in selected bays, nearshore sloughs, channel entrances to bays, and channels that transect shallow lagoons in coastal waters from Florida to South Carolina.

Winter cruises of Florida waters included both the Gulf of Mexico and Atlantic coasts. Ninety-seven trawl stations were made from Cedar Key on the west coast south to Sanibel Island; Cape Sable to Key West; and Jupiter Island to Ponce de Leon Inlet on the east coast (including Mosquito Lagoon and the Cape Canaveral bight). The trawl tow times were limited to 10 to 30 minutes duration to prevent the accidental drowning of any captured turtles.

The survey of Georgia and South Carolina coastal waters was contracted out to Southeastern Wildlife Services, Inc. of Athens, Georgia. Despite the extremely foul weather conditions during the survey period and the wreckage and rock strewn trawling stations selected for investigation, 49 stations were completed. The main objective of this survey was to search for sea turtles that might be seeking refuge from low temperatures in the deeper channels leading to the bays——potential habitats that might be similar to the Cape Canaveral hibernaculum. Man-made channels were primary objectives of the survey. The area surveyed included 8 study sites: St. Mary's River entrance, Georgia-Florida; St. Andrew Sound, Georgia; St. Simon's Sound, Georgia; Savannah River, South Carolina-Georgia; Calibogue Sound, South Carolina; Port Royal Sound, South Carolina; Cooper River, South Carolina; and Winyah Bay, South Carolina.

Results from these trawl surveys, the monthly Cape Canaveral investigations, and a winter survey of coastal habitats from Florida to South Carolina are summarized below.

Results

In the survey of Florida's coastal waters 28 turtles were caught; all but 2 were captured in the Cape Canaveral area. These 2 exceptions were a loggerhead from Ponce de Leon Inlet and a juvenile green turtle from Florida Bay. None of the turtles caught appeared to be torpid or to have been in a hibernating state. Their deep cloacal temperatures ranged from 17.1° C to 18.7° C. The winter of 1978–79 was not as severe as the preceding ones. Difficulty in pulling the net at many of the selected stations may have resulted in the low capture rate outside the Canaveral area. Submerged vegetation, an abundance of sessile, attached benthic organisms, such as sponges and tunicates, and rock (limestone) outcrops frequently hampered the collecting effort on both coasts and the Keys.

The survey of Georgia and South Carolina coastal

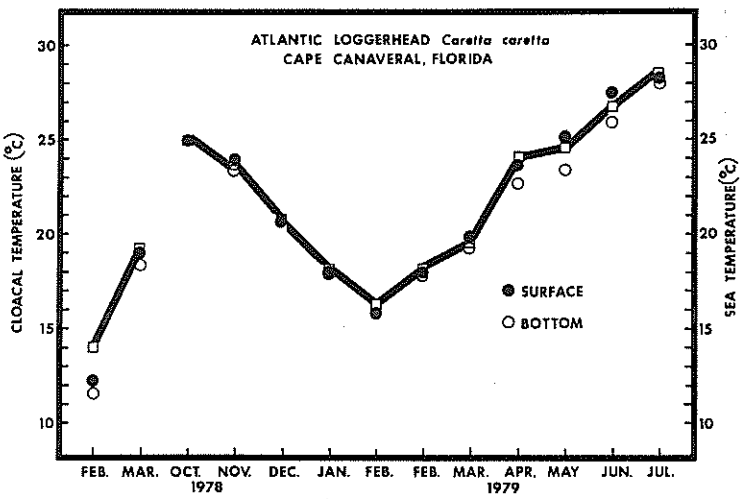

Figure 1. Mean monthly deep cloacal temperatures (open squares) of loggerhead sea turtles (*Caretta caretta*) captured by trawling in the Port Canaveral ship channel (N = 366). Circles are seawater temperatures.

habitats yielded no evidence that hibernating sea turtles occur in the nearshore environment of Georgia-South Carolina despite the fact that the observed winter seawater temperatures fall mostly within and below the range of temperatures reported by Felger, Cliffton, and Regal (1976) and Carr, Ogren, and McVea (1980). The 49 station temperatures recorded in this survey for these latitudes ranged from 7.8° C to 17.0° C. Only 3 stations were recorded above 14.5° C (Richardson and Hillestad 1979).

It is premature to draw any conclusions from these winter surveys because of vast coastal and estuarine areas that remain to be explored. Some of the likely or potential hibernacula located in deep channels, many dredged greater than normal depths of the surrounding waters, simply could not be sampled because of numerous wrecks, debris, and various other trawl obstructions. However, strong currents and extremely

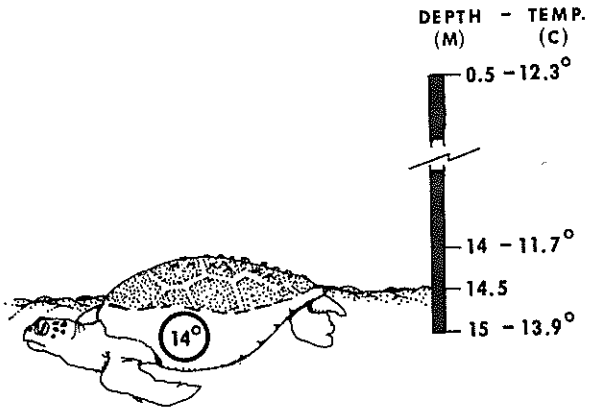

Figure 2. Sketch of a loggerhead sea turtle (*Caretta caretta*) buried in the Port Canaveral ship channel, February 1978. The pattern of staining on the turtles captured suggests this position.

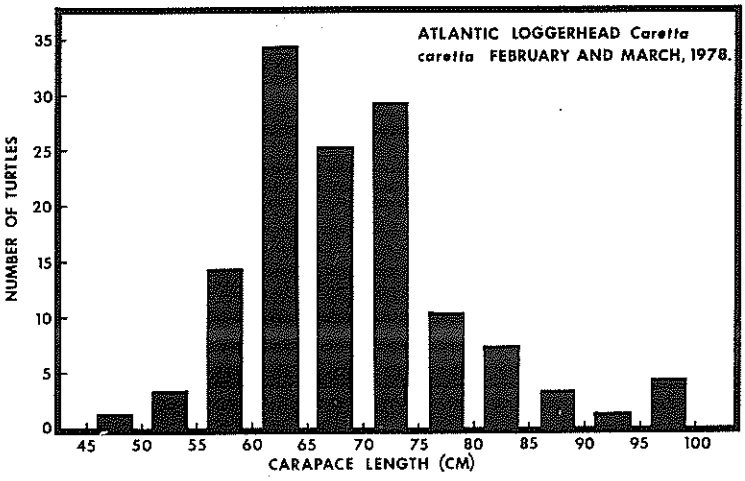

Figure 3. Maximum carapace lengths (straight line) of loggerhead sea turtles (*Caretta caretta*), captured in the Port Canaveral ship channel, February and March 1978 (N = 139).

low water temperatures encountered at the more northern stations in dredged channels may not afford a suitable refuge as is the apparent case at Cape Canaveral with its slight currents and warmer temperatures. In addition, none of the local fishermen and watermen interviewed from the areas sampled north of Florida could provide any information on the occurrence of sea turtles in nearshore waters during the winter months. However, many reported seeing active turtles at the surface along the western edge of the Florida Current (Gulf Stream) over 50 nautical miles offshore during the winter months.

As stated earlier, the monthly trawl surveys at Cape Canaveral were begun in October 1978, in the anticipation that overwintering turtles could be observed for the 1978–79 winter season. It was surprising to discover that loggerheads were not only abundant in the channel locations during February and March as they were the preceding winter, but they were also abundant October through January. In fact, many of them were stained black as described for the previous winter specimens (Carr, Ogren, and McVea 1980). Local fishermen reported that turtles were common in the channel during the summer, with many being captured in September 1978 during shrimping operations. The winter of 1978–79 was mild, however, and sea temperatures in the ship channel remained above 15° C. None of the 23 turtles captured in February, the coldest month, appeared as torpid as they had the previous winter. Their deep cloacal temperatures ranged from 15.7° C to 16.8° C (mean, 16.3° C); bottom seawater temperature was 16° C (Figure 1). There was no indication that they were hibernating in the bottom mud. Observations of turtles at the surface were frequently made at this time; the only difference in their behavior in February as compared to the other warmer months was that they were slower to respond to the approach of the vessel.

Various physiological measurements were made on the trawl-captured specimens during this period to determine more precisely what the effects of low temperatures are on sea turtles. These studies were continued throughout the monthly surveys at Cape Canaveral. A preliminary report of these investigations (Lutz and Dunbar-Cooper 1979) suggests that the blood chemistry of the loggerhead is markedly sensitive to seasonal changes despite the fact that hibernating turtles were not found. Indication of an apparent preparatory state for hibernation was noted by a markedly reduced hematocrit, a fall in blood sodium and blood osmotic pressure, and a rise in blood magnesium. These studies are scheduled to continue.

The Cape Canaveral population of loggerhead sea turtles that was observed hibernating during winter of 1977–78 consisted primarily of subadults (85 percent) (Figure 3). Meristic data obtained from the loggerheads captured at Cape Canaveral during the monthly surveys that followed reinforced the above observation and, in addition, emphasized the bimodal length-frequency distribution that was suggested in the earlier data. The reason for the relatively small numbers of trawl captures of a particular size class (ca. 80 to 85 cm, carapace length) of loggerheads is not clearly understood at this time. The bimodality of length-frequencies from data collected on Atlantic loggerhead size distribution, other than from nesting females, was first observed in Georgia by Hillestad, Richardson, and Williamson (1977 and 1978). Their data were obtained from turtles caught by shrimp trawlers and dead specimens found stranded on the beach. A majority (88 percent) of these turtles were also classified as subadults.

Discussion

Many of the questions raised by Felger, Cliffton, and Regal (1976) and Carr, Ogren, and McVea (1980) concerning the degree and geographical extent of hibernation in sea turtles remain to be answered. Little is known about the various physiological responses and adaptations specifically required by sea turtles while submerged for long periods of time. The observed responses to decreased water temperatures appear to be inconsistent among individuals within a population or species and between age groups; some obviously migrate, some apparently hibernate. The occasional widespread mortality affecting sea turtle populations resulting from exposure to low temperatures is difficult to explain when part of the same population is apparently hibernating in the same general area. The observations of large aggregations of lethargic or moribund sea turtles passively floating miles offshore North Carolina and Florida during winter months are an enigma

(Schwartz 1978; Carr, Ogren, and McVea 1980).

The options available to sea turtles residing in the coastal waters of the United States in response to cold water are summarized in Carr, Ogren, and McVea (1980). The need still exists to investigate other areas, such as mud sloughs offshore, bottom disconformities, wrecks and reefs, deep channels in lagoons, and bay systems, to determine the extent and ecology of overwintering behavior. The locations of the few observations that have been made of hibernating sea turtles in North American waters may be significant and restricted to a narrow latitudinal zone (Figure 4).

Experience acquired during sea turtle surveys conducted over the past year necessitates some re-evaluation of our earlier statements concerning the supposedly unique appearance and behavior of turtles stated in Carr, Ogren, and McVea (1980). The degree of physical activity observed among individuals captured by trawls is 1 example. For this reason, reports of lethargic turtles being captured during winter months by trawlers are not necessarily related to the torpid condition of hibernating turtles. They may have been held underwater too long and become fatigued or comatose. The capture of mud-covered turtles and observations of mud plumes washing from the backs of turtles at the surface are additional examples, which, by themselves, indicate that the turtles are spending considerable time on the bottom. This information is important, however, when correlated with low water temperature, infrequent surface observations, and lethargic behavior. The degree of discoloration of the scutes and integument may be also a result of the time spent on the bottom. Black-stained individuals were collected from October 1978 to September 1979 at Cape Canaveral. The color appeared less intense for these turtles than those observed in February 1978, however. This may represent a combination of long-term exposure to bottom sediments during less-active periods in the winter months and repeated exposures during the rest of the year.

Difficulties in investigating potential and known sea turtle hibernacula are compounded not only by the unpredictability of the event but by sampling limitations. Use of passive gear, such as gill or tangle nets, would not be a successful method for capturing dormant turtles. Trawls, not less than 12 to 15 m headrope length, are very effective provided they can be used on unobstructed bottoms. When the trawling method is used, however, tows must be of less than 30 minutes to avoid stressing or drowning nonhibernating turtles. Use of Scuba may be excellent for observing offshore reefs and some inshore areas. In all cases, precautions must be taken to prevent mortality when capturing dormant turtles for study and tagging. Releasing these turtles immediately to sea might result in cold-stunning and death. Specimens captured under these conditions

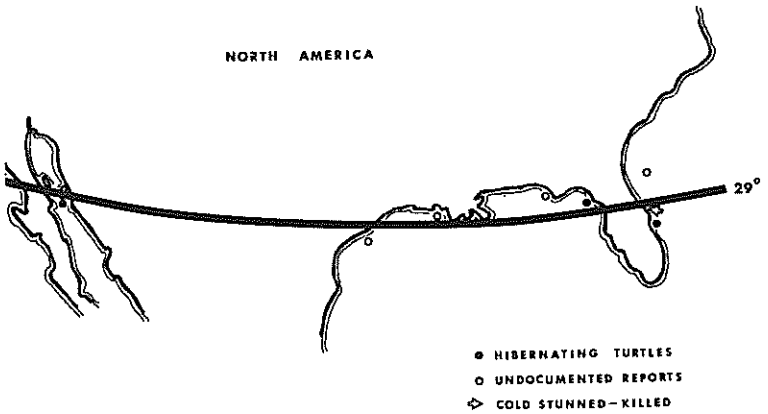

Figure 4. Latitudinal occurrences (including unconfirmed reports) of winter dormant or hibernating sea turtles in North American waters

may have to be held in tanks or pools at higher ambient temperatures for extended periods. This was done by Ehrhart (1977) after he had collected cold-stunned turtles from Mosquito Lagoon and Indian River.

The importance of acquiring additional information on this little known aspect of sea turtle life history cannot be over stressed. Such information would be extremely useful in decisions concerning the conservation of threatened and endangered populations, especially if dormant turtles are located in areas where man's activities could adversely affect them. For example, the Baja California population of green turtles has been severely depleted by divers who overfished dormant turtles during the winter (Felger, Cliffton, and Regal 1976). If knowledge of dormancy had been known, regulations might have prevented overfishing. Another example is the vulnerability of dormant turtles to trawling. This knowledge was applied by NMFS to protect overwintering loggerheads in the Port Canaveral navigation channel. Trawling was declared unlawful at this locality from November 1978 to March 1979.

Further protection of these endangered and threatened species of sea turtles will result from conservation measures based on new data relating to the degree and extent of hibernation in temperate waters.

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